

# Transmission Risk of SARS-CoV-2 Among Close Contacts- Results of Case- Contact Tracing

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## Research article

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# Abstract

**Background:** The ongoing outbreak of corona virus Disease-19 (COVID-19) is rapid escalation and global spread. The epidemiological characteristics and particularly its ability to spread in the human population of COVID-19 were uncertainty. We analyzed infection of 2019 novel coronavirus pneumonia (COVID-19) and close contacts in Fuzhou, Fujian Province, and to understand the risk of infection and morbidity in different exposure mode.

**Methods:** We investigated cases and their close contacts by face-to-face or telephone interview and conducted laboratory test on nasopharyngeal or oropharyngeal swabs or anal swab for evidence of COVID-19 infection. Information on cases including the epidemiology, exposure and laboratory were collected.

**Results:** There were 72 patients of COVID-19 and 1 asymptomatic case were confirmed in Fuzhou. A total of 1159 close contacts were traced, the secondary infection rate (SIR) was 2.07% (24/1159), the median of interval was 12 days (range 2-21 days). In the relationship between close contact and cases, the SIR of old people under care were the highest (28.57%) than family members (5.52%), medical staff (3.23%), relatives (2.41%) and colleagues / classmates (1.67%), respectively ( $\chi^2=534.38$ ,  $P<0.00$ ). Among the contact ways, the SIR of Nursing (nursing home) were the highest (28.57%) than medical care (3.23%), family gathering (2.82%), same building (1.77%) and short talk or handle affairs (1.55%), respectively. The median of incubation period was 5 days (range 1-12 days).

**Conclusions:** The COVID-19 has highly contagious. Timely and strict quarantine should be conducted for close contacts to reduce the possibility of community communication.

## Background

The outbreak of corona virus Disease-19 (COVID-19) caused by the virus SARS-CoV-2, is rapid escalation and global spread, which has become a serious public health challenge. The National Health Commission of China announced that pneumonia with new coronavirus 2019 infection was brought into the class B of legal infectious diseases, and preventive and control measures of class A infectious disease were taken for response to the growing public health threat posed by this new coronavirus. On 20 January, 2020<sup>[1]</sup>. Targeted prevention and control measures were taken to stem the outbreak. In some cities, grid management and neighborhood watches were initiated to detect and isolate suspected cases and their close contacts as soon as possible. From January 20, Fuzhou Health Commission, in collaboration with Fuzhou Center for Disease Control and Prevention (CDC) has taken a series of powerful measures, especially early detection and early isolation. From January 22 to February 29, we confirmed 72 patients and 1 asymptomatic case. We investigated 73 infections of COVID-19 and their close contacts to understand the risk of infection and morbidity in different exposure mode.

## Methods

# Case definition

## Suspect case

A. A person who had fever ( $\geq 37.0$  °C), weakness, cough, sore throat, or shortness of breath, AND had a history of travel to or residence in Wuhan, Hubei Province or city reporting local transmission of COVID-19 disease during the 14 days prior to symptom onset. OR AND had contacted with a confirmed COVID-19 case in the last 14 days prior to onset of symptoms.

## Symptomatic, lab-confirmed case (patient)

Suspected case was tested positive for COVID-19 Nucleic acid in nasopharyngeal (NP) or oropharyngeal (OP) swabs or anal swab.

## Asymptomatic, lab-confirmed case (asymptomatic case)

A person without the clinical symptoms, was tested positive for COVID-19 Nucleic acid in nasopharyngeal (NP) or oropharyngeal (OP) swabs or anal swab.

## Confirmed case

## Close Contacts

A person who had contact (within 1 metre) with confirmed COVID-19 cases during their symptomatic period (including 2 days before symptom onset), and had not taken effective protective measures (e.g. household contacts).

We attempted to obtain the following information of patients and their close contacts: demographic features, clinical characteristics, history of exposure or contact with COVID-19 cases, travel history and activities 14 days before and after symptoms onset.

The relationship between close contact and cases: family member, relative, friends, the old people under care, colleague/ schoolmate/same building, doctors and patients, and other relationship. The contact mode between close contacts and patients: life contact (including living together, family gathering, nursing care in old people's home), in the same vehicle, medical contact (therapy, nursing, in the same ward, at the same time in hospital surrounding), and other contact (such as in same building, short talk or handle affairs).

All close contacts were traced and quarantined in designated quarantine facilities, where clinicians monitor the health status and PCR testing.

We collected nasopharyngeal or oropharyngeal swabs or anal swab of patients and their close contacts. These specimens were tested using real-time reverse transcription-polymerase chain reaction (RT-PCR) for COVID-19 nucleic acid by Fuzhou CDC.

## Results

A total of 72 patients and 1 asymptomatic case were enrolled, including 44 imported cases and 29 local cases. There were 13 cluster events, including ten household transmission (76.9%), two collective workplace clusters (15.4%, one event was in old people's home), one community cluster (7.7%). The 13 cluster events involved 45 (61.6%) patients and asymptomatic case.

The median of interval was 12 days (rang 2–21 days). Figure 1.

A total of 1159 (rang:1-166) close contacts were identified and traced. The secondary infection rate (SIR) was 2.07% (24/1159).

One patient was infected during the incubation period.

## close contacts

The relationship between close contact and cases, the SIR of old people under care were the highest (28.57% ) than family members (5.52%), medical staff (3.23%), relatives (2.41%) and colleagues / classmates (1.67%), respectively( $\chi^2=534.38$ ,  $P=0.00$  ). Table 1.

Table 1  
The relationship between close contact and cases

Relationship	No. of close contacts	No. of infected	SIR(%)
old people under care	21	6	28.57
family members	163	9	5.52
medical staff	31	1	3.23
relatives	166	4	2.41
colleagues / classmates	127	4	1.67
friends	60	0	0.00
others	591	0	0.00

Table 1 showed the relationship between close contact and cases, the SIR of old people under care were the highest (28.57% ) than family members (5.52%), medical staff (3.23%), relatives (2.41%) and colleagues / classmates (1.67%), respectively.

Among the contact mode, the SIR of nursing (old people's home) were the highest (28.57% ) than medical care (3.23%), family gathering (2.82%), same building (1.77%) and short talk or handle affairs (1.55%), respectively. Table 2.

Table 2  
The contact mode between close contacts and patients

Mode	No. of close contacts	No. of infected	SIR(%)
<b>life contact</b>	350	19	5.43
Nursing (in old people)	21	6	28.57
living together	152	8	5.26
family gathering	177	5	2.82
<b>Other mode</b>	281	4	1.42
In same building	113	2	1.77
short talk /handle affairs	129	2	1.55
Other same surrounding	39	0	0.00
<b>Medical contact</b>	139	1	0.72
therapy, nursing,	31	1	3.23
in the same ward,	3	0	0.00
at the same time in hospital surrounding	105	0	0.00
<b>Dinner together</b>	60	0	0.00
<b>In the same vehicle</b>	329	0	0.00

Table 2 showed the different contact mode, the SIR of nursing (old people's home) were the highest (28.57% ) than medical care (3.23%), family gathering (2.82%), same building (1.77%) and short talk or handle affairs (1.55%), respectively.

Except asymptomatic and cases with unknown contact history, there were 19 cases eligible for estimate incubation period. The median of incubation period was 5days (rang1-12days). Figure 2.

Figure 1 showed the time course of the epidemic of COVID-19 in Fuzhou. A total of 72 patients and 1 asymptomatic case were enrolled, including 44 imported cases and 29 local cases.

Figure 2 shows interval between secondary cases and imported cases. The median of incubation period was 5days (rang1-12days).

## Discussions

We have shown that there were 72 patients and 1 asymptomatic of COVID-19 in Fuzhou, Fujian province, involving 13 cluster events, and among these, there quarter were household transmission. A total of 1159 close contacts were identified and traced. The secondary infection rate (SIR) was 2.07%. The median of

interval was 12 days (rang 2–21 days).The nursing in old people`s home have higher infectious than others.

SARS-CoV-2 is the seventh member of the family of coronaviruses that infects humans, however, the number of infections has well exceeded that of the Severe Acute Respiratory Syndrome (SARS) and Middle-East Respiratory Syndrome (MERS) outbreak in 2002 and 2013 respectively<sup>[2]</sup>. A recent research showed, the mainly SARS-CoV-2 is believed transmitted mostly via droplets or direct contact. Everyone is all generally susceptible to the virus <sup>[3]</sup>. In this investigation, the SIR of old people under care, family number and medical staff were higher than other, which indicated specific surroundings, such as old people`s home, household, hospital, were high risk areas. These results highlight that living together, sharing daily necessities (e.g. toilets), close contact and more long time contacting make communication easier, which indicate it is perhaps better for centralized isolation instead of home isolation for close contacts to reduce the intrafamily transmission and community transmission, strengthen case monitoring and screening, and quicken the identification and tracking of close contacts. At the same time, we should strengthen the control of nosocomial infections.

Asymptomatic case was found in the final days of the quarantine. He may have been secondary cases within a given quarantine, or may have been infected before the quarantine began. If not insulated for medical observation, he could not be found in the special period, and will spread to the other persons. Bai Y et al. and Zhiliang Hu et al. reported asymptomatic carrier had potential transmission of SARS-CoV-2, and the communicable period could be up to three weeks, even as long as 29 days <sup>[4, 5]</sup>. These results highlighted the importance of close contact tracing and systematic testing of asymptomatic cases before disisolation are necessary to reduce the size of the outbreak of COVID-19. We suggest that isolation medical observation for close contacts, in addition, pathogen screening was carried out when the close contacts was in or out of quarantine.

Crowd with high SIR of COVID-19, especially family members, old people`s home, welfare house, we should increase the frequency of nucleic acid detection and lengthen quarantine time (21days).

In this research we found same building, and short talk or handle affairs with patients could also cause infections, which highlighted high transmissibility and herd susceptibility of covid-19.

## Conclusions

This investigation highlighted that COVID-19 had highly contagious. Old people in old people`s home, family number and medical staff have higher susceptibility. Timely and strict quarantine should be conducted for close contacts to reduce the possibility of community communication. The limitations of paper was that some of close contacts were no tested for nucleic acid test in early period, so may have missed a few asymptomatic cases.

At present, the pandemic of globally is sustaining. Therefore, we must act together to stop the spread of the COVID-19. Timely and strictly centralized isolation for close contacts, and early nucleic acid

monitoring should be conducted, that can find cases and reduce the possibility of community transmission. It is necessary to prolong the time of isolation. More studies should be done to judge the infectivity during the incubation period of COVID-19.

## **Abbreviations**

COVID-19: Corona virus Disease-19

CDC: Disease for control and prevention

WHO: World Health organization

SIR: Secondary infection rate

## **Declarations**

### **Ethics approval and consent to participate**

This field investigation did not involve endangered or protected species, and no human subjects' specimens were obtained. Such outbreak investigations are considered by Fuzhou Disease for control and prevention's Ethical Review Committee to be exempt from IRB review as they are considered public health emergency acts. All participants provided written informed consent (the parents provided informed consent <18 y of age). Data used in the evaluation were anonymized. Individual identifying data were not retained in analytic data sets.

### **Consent for publication**

This manuscript don't contain any individual person's data (including individual details, images or videos)

### **Availability of data and materials**

No

### **Competing interests**

All authors have read and approved the manuscript and declared that they have no competing interests.

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## Authors' contribution

Dr. HMJ, MHC, HWW, YWC, JQW, and XYZ led the field investigation. HMJ wrote the manuscript. HMJ, MHC, HWW, CPG collected and interpreted data

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## Figures

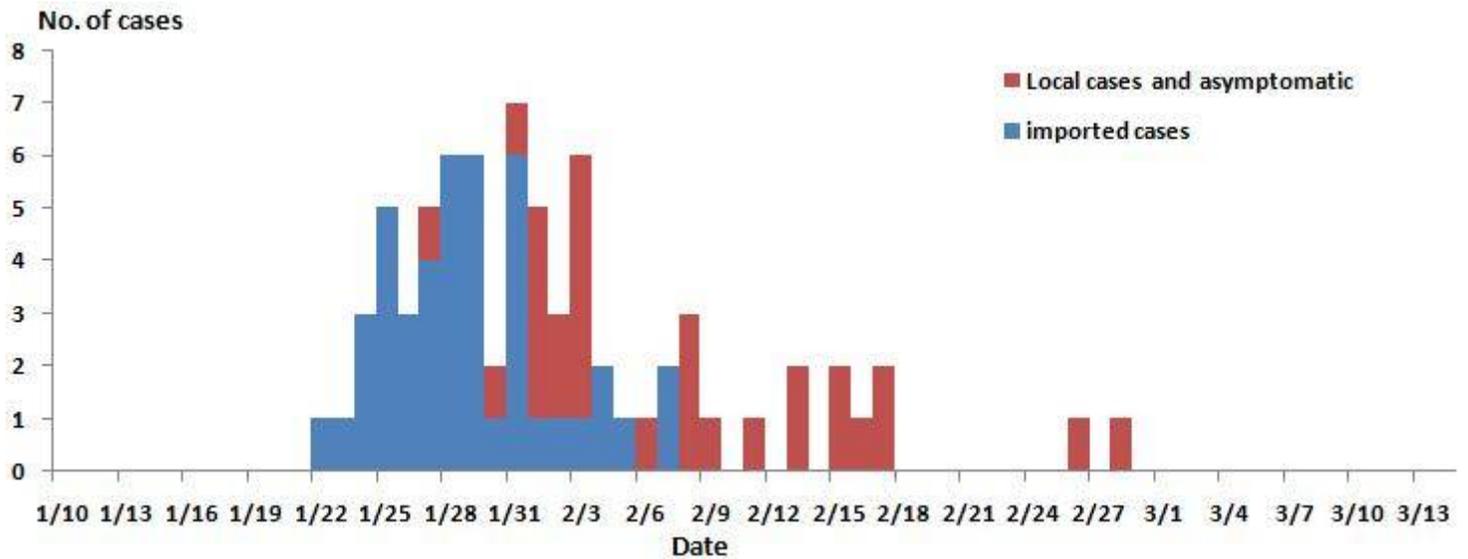


Figure 1

Daily distribution of COVID-19 cases by date of diagnosis in Fuzhou , 2020

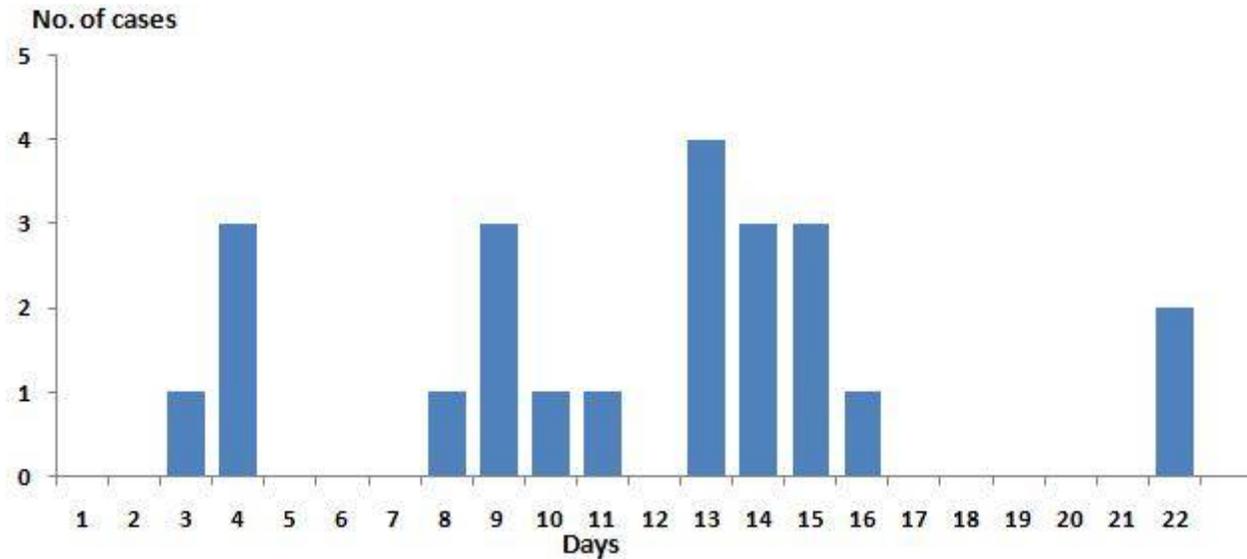


Figure 2

Interval between secondary cases and imported cases in Fuzhou, 2020

## Supplementary Files

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- [informedconsentofprimarypatient.jpg](#)